

REPORT OF THE STATE NATURAL GAS SUPERVISOR.

LETTER OF TRANSMITTAL.

OFFICE OF THE NATURAL GAS SUPERVISOR, }
KOKOMO, IND., Jan. 25, 1898. }

PROF. W. S. BLATCHLEY,

State Geologist:

Sir—I transmit herewith to you my third annual report. It is made in obedience to section 7,504 of the Revised Statutes of the State of Indiana, and is for the year ending December 31, 1897. It is the sixth annual report from this department.

It is due for me to say at this time that during the past year I have had frequent occasion to ask your aid and counsel, and for the same I beg to tender my grateful acknowledgment.

Yours respectfully,

J. C. LEACH,

State Natural Gas Supervisor.

INTRODUCTORY.

A brief outline of the subjects discussed in the body of this report and such other matters as have not a logical connection with the same, but merit a passing notice, are given in this introductory chapter.

For reasons patent to every person acquainted with the condition of the gas field and the character of the work occasioned thereby, the time that I have had to devote to this report has been very limited. As the natural gas industry in this State becomes older the developed area increases by the drilling of wells and extension of pipe lines, and in further consequence of the extraordinary activity in the oil industry in high-pressure gas territory during the past year, it has been necessary for me to devote all of my time to the work in the field. At this time the importance of aggressive field work can not be overestimated. Every working day in the year is needed for this work, and, while I do not wish to undervalue the history of the progress of this or any other natural gas field of any importance, the doing of the work, especially the efforts to stop the vandal-like waste that has characterized some sections of this field during the past, is more important than a record of the same.

Regarding the purpose of the reports from this department, I quote from my first annual report:*

"The reports from this department, to be of value, should contain such information as the public desires to know, and discuss such subjects as demand the attention of those engaged in the natural gas industry in Indiana. They should contain an accurate history of the gas field; a history in which all phases of the subject are discussed and in which the condition of the field has been noted from time to time."

A discussion of the scientific questions suggested by the generation, storage, pressure, etc., of natural gas would be a reiteration of portions of former reports. This would not be profitable, even if practicable, at this time.

*Twentieth Annual Report of the Department of Geology and Natural Resources, Indiana. 1895.

Soon after the discovery of natural gas in Indiana, and even before this, during the time that the Findlay, Ohio, field lasted, the scientific phases of the natural gas question were considered by the ablest scientists in America, especially geologists. Nor were they alone. Manufacturers and persons variously interested in this new industry, not only watched the progress and development of the field, but were anxious to find a logical answer to the numerous questions suggested by the developing of this field. The same cause was not responsible for the interest manifested by the two classes of people. With the former a logical solution of a question in nature was the reward, while with the latter these questions were interesting because of their relation to the future of the natural gas industry. Not a few reached the happy conclusion that the life of this gaseous fuel would be equal to all time. This to a majority, including all geologists, was not a sound conclusion, nor one that the facts involved would substantiate. The latter said that the stock of natural gas is practically fixed, and when once exhausted there is no provision in nature for its renewal. The history of the field during the past ten years and its present condition attest the truthfulness of this conclusion. The exhaustion of territory once productive; the decrease in the rock pressure; the advance of the salt water horizon, and, in fact, all the conditions surrounding the field point to the final exhaustion of the supply. With this in mind it is apparent why consumers and persons variously interested in the natural gas industry, who are acquainted with these conditions, are so anxious about the ever-changing condition of the field. Information as to progress and development of the field, the advance of the salt water horizon, the decline in the rock pressure, and everything that tends to diminish the productiveness of the field is most sought now.

It is not, how is it generated? Under what conditions is it stored, or, what causes its pressure? but, what is its rock pressure? What is the rate of decrease of the same? What can be done to effectually combat the effects of the salt water, or what appliances are most economical; produce the most heat with the least amount of gas?

As has been said, the condition of this field is continually changing. New limitations are encountered and unforeseen difficulties arise, which those engaged in the natural gas industry should be prepared to meet. In one section the salt water is found in the upper strata of the natural gas rock; in another petroleum deposits are found, while in some localities the limestone is very hard, lacks porosity, and consequently the wells are very unproductive at first, and soon fail, owing to a stoppage of the rock. These difficulties are dealt with

differently in the various localities of the gas field; sometimes successfully and sometimes not. A careful study of these questions and prompt action always does some good, and frequently prolongs the life of the well for many months, or even years. Being guided by observation in the field and experience, I have tried to make this report along the lines indicated above as practical as possible, endeavoring to answer those questions most frequently asked, and to give such advice and such recommendations as will, in my judgment, do most to preserve the present supply of this valuable fuel. The chapters on the "Condition of the Field," found in the successive annual reports from this department, are a history of the field from its beginning, and for the reason, with others stated above, that a majority of the people interested in the natural gas industry care more for present condition than "theories," first consideration is given to the former in this report.

MAP OF THE GAS FIELD.

The map of the Indiana Natural Gas Field accompanying this report will, it is thought, be a valuable aid to those who are studying the field. The original gas area is shown, and by the pipe lines and wells both the developed and undeveloped territory can be located. Owing to the limited space only about 17 per cent. of the wells are marked. The principal pipe lines, not service lines, are located. The general direction of the pipe lines are given, the frequent angles found in some being omitted. The location of tributary pipe lines are not shown.

OIL FIELD.

The oil industry has been very active during the past year, and while a report on this subject is not included in the duties of this department, because of its close relation to the gas industry in some sections of the field, the location of oil territory is shown on the map, and reference is made to the subject in its appropriate connection.

STATISTICAL INFORMATION.

The statistical information specified by the law authorizing reports from this department, has been very fully given in former reports, and in the reports of the State Geologist and Bureau of Statistics. They are not repeated here.

ACKNOWLEDGMENTS.

In performing the work of this office during the past year gas companies, manufacturers, farmers and drillers have rendered me much assistance, without which my work would have been much more arduous and less effective. To all these and others who have aided me, I desire to return my grateful acknowledgments.

THE INDIANA NATURAL GAS FIELD.

A BRIEF REFERENCE TO ITS HISTORY AND DEVELOPMENT, AND ITS
PRESENT CONDITION.

Natural gas was found in Trenton limestone, near Portland, Indiana, March 14, 1886. This was the beginning of an era of exploration, the most important result of which was the location of the Indiana natural gas field. The first well was small compared with the average since drilled in this field. The eastern edge only of the gas rock had been penetrated. The second well was drilled at Eaton, Delaware County, the following September, and the third at Kokomo, Howard County, in October of the same year. Though the well at Kokomo was as near the western edge of the field as was the well at Portland the eastern edge, it was much more productive, discharging at least 3,000,000 cubic feet of gas daily for four years. This well, with others in that territory, succumbed to the invasion of the salt water before the rock pressure of the field showed a material decrease. The well at Eaton produced more gas daily and for a longer period than either of the above wells. Kokomo is sixty-two miles west of Portland. Eaton is eight miles south of a straight line connecting Portland and Kokomo. The drilling of numerous wells between these two points soon demonstrated that the territory intervening was gas-producing. Incited by the nearly universal success of the drill in this region, companies were organized in almost every county in the State, and the drill started on its mission of exploration.

At that time but little was known of the formation in which the gas is stored, nor was more known of the origin of this hydrocarbon. The relation that the textural and structural conditions of a rock, in

which the lighter hydrocarbons are stored, bears to the production of the same had not been considered by the local geologists. The great value of natural gas as a heat-producing power and the fact that the first wells indicated a very large if not an inexhaustible supply of it, were incentives sufficient to develop the field, and finally to locate its boundaries. However convenient and valuable the new fuel was thought to be, but few, if any, imagined the great change to be wrought in this section of the State within the next decade on its account.

Natural gas had been found in Trenton limestone, a universal formation in this State. Was it a universal gas-producing rock? If not, why not? Answers to these questions were reserved for the future. All theories had to conform to the story of the drill.

The Trenton limestone in this State is a reservoir for natural gas over a limited area only. From Portland west to Kokomo; from Greensburg, Decatur County, north to LaFontaine, Wabash County, an area of about 2,500 square miles. It must not be understood that this entire area is gas-producing at present, for nearly, if not quite, one-half of it has been practically abandoned; has been overrun with salt water. Outside of the original gas area the Trenton limestone is, with a few exceptions, barren, while within, with similar exceptions, it is the most productive gas rock in the United States.

As would be expected, there were many failures in the search for gas in the State of Indiana and an immense expenditure of money, but the "gas belt" was located and in addition the large number of deep wells drilled in the various sections of the State revealed the character and condition of the underlying strata; increased the knowledge of geology of the State and the popular respect for the same.

Now that it was possible to obtain definite knowledge of the geological structure of the State, scientists soon began to investigate the conditions that controlled the origin, accumulation, etc., of natural gas and oil, and the result was that reasonable theories accounting for the same were presented, discussed and accepted by the leading geologists of the country. Nothing has been added to these conclusions recently. Time confirms their truthfulness. A discussion of the subject, or even a statement of the commonly accepted theories regarding the same, would simply be a reiteration of what has been said in former reports from this department. However, it may be said that the data obtained by scientific investigation or practical observation did not warrant the conclusion that natural gas would last forever, but quite the reverse.

The geologists of the State were the first to warn the people of the gas belt against the vandal-like waste that was so often seen during the early history of the field, and I am sorry to say can be seen in some localities yet. But little attention was given to the subject at that time, and the statements made that the supply of natural gas was limited, was being diminished each day by the amount of gas used and wasted, were labeled as idle assertions, made in the interest of gas companies. The difference of opinion on the subject is not so marked now as it was in the past, nor are the commonly accepted views based on theories. The evidence is present everywhere in the field that the supply of this valuable fuel is being rapidly exhausted.

The people of Indiana knew of the value, as a heating power, of natural gas even before they knew that within the borders of their own State was the largest, as well as most productive gas area of the world. They knew of the Pennsylvania and Ohio fields. They had heard of the wonderful growth of Findlay and other towns in Ohio; how they had grown from villages to cities in a short time; how small agricultural towns had been transformed into thriving manufacturing cities. This was the kind of prosperity the Indiana towns hoped to see. As we shall see hereafter they began to advertise their fuel resources and other advantages far and wide. To many this was not in vain. Small country villages soon became prosperous manufacturing towns, with the conveniences of cities, and the large cities can boast of twice their former population. The gas belt is the manufacturing center of the State. The discovery and utilization of natural gas as a fuel has caused this almost miraculous change within the last ten years. When the supply of natural gas is exhausted other changes will be necessary. There is little doubt but that, in most instances, other fuels will be successfully used.

It is certain that the time will come when the supply of natural gas will not be sufficient for manufacturing purposes, and it is equally true that a large per cent. of the factories in this section located on account of its fuel privileges. I am glad to know that the indications are that the gas belt will remain the manufacturing center of the State after the natural gas supply has been exhausted. A majority of the factories using gas are substantially built and are doing a prosperous business. They are advantageously located with regard to the great jobbing centers and transportation facilities to the same. Referring to the condition of the manufacturing industries in the gas field, I quote from my last annual report:*

*Twenty-first Annual Report of the Department of Geology and Natural Resources, Indiana. 1896.

"While a change of fuel will be necessary in the future, and no person knows this better than the manufacturers, there is no cause for immediate alarm. Manufacturers know and appreciate the value of natural gas, and are providing for the future as far as possible. The larger factories, located near cities where the field shows signs of exhaustion, have pipe lines and sufficient territory to protect their interests. Others located where the consumption for other purpose is light, are drawing from wells in the vicinity of the factory, two hundred feet of pipe in some instances being sufficient. True, a majority of the first wells drilled show signs of exhaustion, but in many cases the territory is only partially developed, and the new wells are usually productive. Any signs of a shortage in the fuel supply causes much anxiety regarding its future on the part of the manufacturers, and this is usually followed by more care and economy in its use.

"Further inquiry shows that other fuels can be used without serious inconvenience to supplement the supply of gas where it fails to come to the full requirement of the manufacturing plants.

"Of course, the chief reason for the location of factories in this section of the State during the last nine years are the advantages possessed by this fuel, but evidence is present that the proximity to the markets of the country and the splendid railroad facilities possessed were considered, and, while it is true that some manufacturers who have outlived a less productive gas field are apprehensive concerning the future, they are disposed to find another fuel, if it is necessary, rather than a new location. Taking into consideration the present condition of the field, the proximity to the Indiana coal field and its railroad connection with the gas field, it seems that a majority of the industries of the Indiana gas belt are permanently located."

The conditions have changed but little since the above was written. The draught upon the field for manufacturing purposes has been extraordinarily light for the past two years. A few factories have been compelled to change their plan for fuel supply, and in a very few instances, factories located near the edge of the field or in localities remote from pipe lines, have either changed to other fuel or are supplementing their supply of gas with wood or coal. It is reasonable to suppose that this will continue where necessary in the future. I do not know of a single instance where a factory has left the gas belt on account of the fuel item.

It is in the progress and present condition of the natural gas industry that we are most interested. We have been enjoying its use, both as a manufacturing and domestic fuel, since 1886. In the light of the past history of the field and its present condition, how long will

it continue? Is this gaseous fuel being generated as we use it, or is there a fixed stock, upon which we are drawing? I will leave the first question until the condition of the field is given. The other question need hardly be mentioned at this late day. While it is probably true that natural gas is being generated daily, and will so continue as long as material out of which it may be, is in the earth's crust, it is equally true that the amount generated daily is not more than a small percent. of the amount wasted under ordinary conditions. Practically the stock of natural gas is complete, and every cubic foot either consumed or wasted, reduces the supply by that amount, and brings us that much nearer to the time when the supply will cease to honor the draught that is being made upon it from day to day.

When the gas field was located and the boundary of the gas-producing area established, it was not known that the Trenton limestone was a productive rock over the entire field, until wells were drilled in every town and hamlet and every township over the entire area. The wells drilled for exploring purposes were quite sufficient to supply the domestic consumption the first year of the history of the field.

At first but few people knew how to control or use the new fuel. From the larger cities and towns committees were sent to the older fields to investigate safety appliances and methods of consumption.

Gas companies in the smaller towns and country took advantage of the information thus obtained, and it was a very short time after the discovery of gas until it was possible for every resident within the confines of the field to use gas for fuel and light. While, as I have said, the people in the gas belt soon became acquainted with methods of consumption, I am sorry to say that but few have learned how to use this fuel as economically as its value warrants, nor is it probable that much attention will ever be given to this very important phase of the subject as long as gas is sold by the "contract system."

Doubtless natural gas is most valuable as a domestic fuel, yet this fact does not attract from its value as a manufacturing fuel, as a heat-producing power. Manufacturers were not slow to learn this, and were soon investigating the new field. The advantages that a city and the surrounding country would derive from large manufacturing industries were apparent. Many factories were anxious to locate in the gas belt, and to secure these a sharp competition arose between the cities and towns seeking to locate them. Most of the towns offered subsidies in the shape of land, free fuel or cash subscriptions. While inducements in the way of cash to cover the expense of moving a manufacturing plant, or land for building purposes may be proper, nothing can be said in favor of giving "free gas," as

was done in many instances. The result is invariably a lack of business-like economy in its use. I am confident that if free gas had never been included in the subsidies offered manufacturing establishments, and if they had been compelled to pay a reasonable price for their fuel, that its value would have been appreciated more highly, and as a consequence an economy commensurate with this would have been practiced. "Free fuel" has been used too freely in most instances for the highest good of the natural gas industry.

NATURAL GAS AND OIL.

Natural gas and oil are usually referred to as associated products of the earth's crust. They unquestionably have the same general history, and the fact that their origin and the conditions under which they are stored are practically the same, are sufficient reasons for this. Then, with all the facts in mind regarding the origin and nature of these hydrocarbons, it is not unreasonable to search for both in the same locality, though the idea that "oil follows gas," as is so frequently stated, is erroneous. That has not been the history of gas and oil fields in other States, nor has it been found true in this State. Reference will be made to this subject in another section of this report, and it is only mentioned here incidentally to show the apparent reason for the presence in this field of oil operators soon after its discovery.

It was not long after it became known that Indiana contained a large and productive gas field until large tracts of land were leased for both gas and oil, and a few test wells drilled. So far as I know nothing was found to encourage further development for oil. The territory leased was in the heart of a productive gas field, and it seems true that it was with these oil operators in possession of large tracts of gas territory, that the pipe-line idea in this State originated. The organization of a company to construct a pipe line from the Indiana gas field to Chicago stimulated the Indiana towns near the field to investigate the subject. The result is known. Indianapolis, Crawfordsville, Lebanon, Frankfort, Lafayette, Logansport, Peru, Wabash, Huntington, Bluffton, Ft. Wayne, Decatur, Union City, Richmond, Connersville, Shelbyville, Chicago and western Ohio are connected with the most productive portion of the field, each by one or more pipe lines. Prior to the construction of these lines no systematic drilling had been done. It was not necessary for factories to go outside of their own yard, or cities beyond their limits for fuel. A few wells were drilled in the country, and "farmer lines" could be found

along the principal highways. With the pipe lines came a more systematic and complete development of the territory. The various lines entered the field at the nearest point and have been extending toward the center of the field from year to year. A uniform extension of the principal pipe lines would find the center of the field between Fairmount, Grant County, and the northwest corner of Delaware County. With the exception of the Indianapolis lines, but slight extensions toward the center of the field have been made this year. Wells have been drilled mainly to supply lateral extensions. An examination of the map accompanying this report will give the reader accurate information regarding the location of the various pipe lines, pumping stations, etc.

The territory occupied by the various pipe lines at present is practically "drilled out." The drilling of any considerable number of wells in the future will involve main-line extensions.

For a number of years cities were supplied with fuel for both domestic and manufacturing purposes from wells within their corporate limits. While this is true yet in a few instances, it will soon be a thing of the past. Pipe lines are becoming a necessity. As a rule the larger manufacturing institutions maintain their own independent pipe lines, while the smaller factories are supplied by gas companies. The map indicates cities and towns in the field that pipe gas for any considerable distance for either domestic or manufacturing purposes, also those that obtain gas from the immediate vicinity. Of the larger towns, Elwood, Alexandria and Hartford City are still depending largely on the first wells drilled for their fuel supply. While the wells at these places remain productive, their closed pressure has decreased uniformly with the field.

At present there are about 250 square miles of territory that has not been invaded by pipe lines. In this section, which includes parts of Grant, Madison and Delaware counties, enough wells have been drilled to supply the local consumption only.

I am often questioned as to the miles of pipe line in the State. If by pipe line is meant all gas pipe, regardless of size, that is used to convey gas, then the question becomes exceedingly difficult to answer. If, however, by pipe line is meant the larger lines, those usually termed pipe lines by gas companies, then a fairly accurate estimate can be made. Taking into consideration all lines four inches and over in diameter, there are near 1,300 miles in the State.

While all the territory within the confines of the natural gas field, as shown on the map accompanying this report, either is at present or has been gas producing, all parts are not alike productive. With the

fact in mind that the productiveness of a gas rock is governed entirely by its structural and textural condition, the above does not seem unnatural. If the Trenton limestone is very porous and the gas passes freely from the rock to the well, thereby permitting a heavy draught without materially lowering the density of the gas in the rock, wells drilled in the same will be productive, while if there is a lack of porosity in the rock, and the gas passes through it slowly, the reverse will be true.

The structural condition of a gas rock may be such that the wells can not withstand a heavy draught, even for a short time, without inviting the salt water. In some sections of the field strong wells, with a rock pressure of over 250 pounds, have been overcome by this agent, while in other sections wells with less than 100 pounds rock pressure continue serviceable. Then, the number of wells drilled in any locality to supply a given consumption, is controlled largely by natural conditions. In one section the rock is very hard, the wells are small and a large number are necessary to supply the domestic consumption. However, it may be said that wells of small capacity, because of the uniform and close texture of the gas rock in a given locality, maintain a higher rock pressure and are longer lived than wells in more porous rock. This can be demonstrated in the extreme southern part of the field. For a detailed account of the conditions necessary for gas accumulation, as well as those present in the Indiana field, the reader is referred to the Twentieth Annual Report of the Department of Geology and Natural Resources of Indiana, 1895, pp. 383-5. That the conditions in the southern part of the field may be understood the above is briefly referred to here.

The reservoir in which the supply of natural gas in this State is stored, is a low, broad elevation or arch, the Cincinnati arch, that crosses the eastern boundary of the State between Lawrenceburg and Liberty, and extends in a northwestern direction across the State. This arch is found at a depth of 349 feet below the surface, 158 feet above sea level, where it enters the State, and 1,300 feet below the surface at Valparaiso, or 602 feet below sea level. It is found at sea level between Elwood and Kokomo. The incline to the northwest is not uniform and the surface is very uneven in some places, consisting of numerous small ridges or folds, with occasional spurs extending at various angles from the main elevation. The Cincinnati arch acts as a trap, in which the gas in this field accumulates. It is held in this gas-holder under an enormous pressure, due to the weight of a column of water back of it. The gas is prevented from escaping by a covering of Utica shale, which is impervious to water and gas, and forms a perfect cover for the Trenton limestone.

"Wherever the Trenton limestone is a gas or oil rock, it is always substantially a pure dolomite, highly crystalline and of a sufficient porosity to contain large quantities of these hydrocarbons. Its storage capacity is much greater than that of sandstones. Outside of the gas area the conditions are different. There the limestone is nearly pure and non-porous. The dolomitic change has not taken place. From the above it is plain that the porosity of the Trenton limestone is due to its chemical composition, or at least connected with it. In the oil and gas area this limestone has been transformed in its upper beds; the carbonate of lime giving way in part to carbonate of magnesia."*

With what has been said regarding the geological structure of the gas field and the general limitations surrounding the same in mind, a specific mention of the general condition of the various sections of the field will be better understood.

THE CONDITION OF THE FIELD.

The southern extremity of the Indiana natural gas field is in Decatur County. But little gas has been found south of Greensburg. The productive portion of the Trenton limestone in this county is very thin, varying from five to ten feet thick. It is very hard and lacks the porosity found in the northern part of the field. The gas passes very slowly from the rock to the well, and consequently the wells are very small, the average not supplying over twenty families with domestic fuel. With all this, the indications are that the gas supply will last longer here than in the more productive parts of the field. The texture of the rock nearly precludes the possibility of overworking the wells. Salt water is not present to a dangerous extent, and it seems almost incredible, nevertheless it is true, that the rock pressure in this section at this late day is 300 pounds. That part of Decatur County, north and west of Greensburg is gas-producing. The territory in the vicinity of St. Paul and the southwestern part of Rush County are similar to the territory just mentioned, except that the rock pressure decreases toward the north. Nine miles northwest of Rushville it is 255 pounds. About one-half of Rush County is gas territory. The northwest part of the county in the vicinity of Carthage has to combat the influence of the salt water more than the territory farther south, and consequently has a lower rock pressure.

*Twentieth Annual Report of the Department of Geology and Natural Resources, Indiana, p. 383.

That part of the original gas area in Shelby County is producing but little gas at present. All of Hancock County, except the southwest part, is in the gas field. While it is not as productive as some portions of the field, many good wells have been drilled. The rock pressure varies from 150 to 200 pounds, owing to the age and condition of the well. Greenfield and Shelbyville are supplied from this county. Every section of Henry County has been tested for natural gas. A number of failures have been recorded in the southeast part of the county. The west half of the county is most productive. Knightstown has an ample supply of gas from territory six miles northwest of the city. Shirley, on the boundary between Hancock and Henry counties, has some good wells, and the territory in the northwest part of the county is still producing some gas, though the salt water is very intrusive.

But a small area in the northwest part of Wayne County has produced any gas, and it is practically exhausted. Though the northern part of Marion County has been thoroughly tested for gas, not enough has been found to place the county in the gas field. A few wells drilled at Broad Ripple during the past year are producing some gas. Hamilton County, with the exception of a small area in the southwest corner, is gas territory. This county claimed some monster wells during the early history of the field. The three pipe lines from Indianapolis pass through the eastern part of this county, and have drawn heavily upon its gas resources. At present the salt water is very troublesome, and the rock pressure of the eastern half of the county is not above 190 pounds.

Crawfordsville and Lebanon are being supplied from territory north and east of Sheridan. The rock pressure there is higher than in the eastern part of the county.

All of Tipton County, except a small area in the northwest corner, is in the gas field. Early in the history of the field a few test wells drilled at Tipton, the county seat, were failures, from what cause it is not known; for in 1896 a well showing a rock pressure of 270 pounds and a daily capacity of 1,500,000 cubic feet was drilled one-half mile east of the city. The Lafayette and Frankfort pipe lines pass through this county, and until recently were supplied from its territory. That part of the county west of Tipton is practically exhausted. The rock pressure of the eastern part of the county is not above 210 pounds.

Randolph County west of Winchester is in the original gas field. The east one-half of this area has been abandoned. Wells in the vicinity of Parker show oil. The best wells show a closed pressure of 190 pounds. The western part of Jay County has proven to be a

valuable gas field. Though the wells drilled in the vicinity of Portland have long since been abandoned, wells in the extreme western part of the county, with a rock pressure of 125 pounds, are still producing gas in valuable quantities. The wells in the vicinity of Dunkirk show a rock pressure of 195 pounds.

Of a number of test wells drilled in Wabash County a few in the vicinity of LaFontaine produce gas in small quantities. The wells in Miami County, with a few exceptions in the vicinity of Converse, have been abandoned.

The eastern part of Howard County, though on the edge of the field, contains much valuable gas territory. Kokomo was one of the first, if not the first, city in the gas belt to use the new fuel. Nearly every well drilled in the vicinity of Kokomo was a "gusher." The structure of the rock is such, however, that the salt water soon overrun the territory, and now this city is piping gas from the eastern part of the county, a distance of twelve miles. The rock pressure in this part of the field is 210 pounds.

For convenience, Grant, Madison, Blackford and Delaware counties will be considered together. They are all in the original and present gas-producing area, except a narrow strip of territory along the northern edge of Grant and Blackford counties. The principal pipe lines draw largely from these counties, and Grant, Madison and Delaware contain the only territory in the field not threaded by pipe lines.* Southeastern Grant, northeastern Madison and northwestern Delaware County have not been touched by pipe lines, and have had only enough wells drilled to supply the local consumption and thoroughly test the territory. This territory is certainly the "heart" of the field. It contains about 250 square miles. Its average rock pressure is 215 pounds. This is a decrease of 30 pounds during the past year. The average rock pressure of the four counties under consideration, not considering the territory in the vicinity of Alexandria, is not far from 200 pounds.

In the vicinity of Alexandria the decrease in both the rock pressure and volume of flow of wells has been greater than in any other part of the field. This is attributed to the heavy draught upon this section by the oil industry.

In speaking of the condition of a field I have referred to the rock pressure only, for the reason that it is the popular way of indicating its productiveness, many believing that accordingly as this is high or low, so is the productiveness of the field great or small. This in a

*See map accompanying this Report.

great measure is a mistake. While a decrease in the rock pressure indicates a general diminution in the supply of the field, it does not indicate the volume of flow when applied to a particular well, or the permanence of its supply. Wells in a given territory registering the same rock pressure, usually vary in capacity. A well with a rock pressure of 210 pounds shows a daily capacity of 4,000,000 cubic feet, while another on the same farm, showing the same rock pressure, will only flow 1,000,000 cubic feet daily, or less. The reasons for this are found in the difference in the draught on certain areas, and in the texture of the rock. When a well is closed it becomes a part of the main reservoir, and if all the wells in the field should be closed, each in a short time would show the same rock pressure; the normal pressure of the field. That is to say, the gas in each well would register the maximum rock pressure of the field, because the gas in the wells would be of the same density as the gas in the rock. The time required to obtain this varies in different localities. Where the gas rock is very porous, permitting the gas to pass through it freely into the well, the maximum rock pressure is reached quickly when the well is closed. When the well is open into the line, the density of the gas in the well does not show a marked change, and the volume of flow is large. If the conditions are changed a change in the result will follow. That is to say, if there is a lack of porosity in the rock, the gas thereby passing through it slowly, the capacity of the well will be small, and when the well is closed, the gas will reach its maximum density slowly, though finally showing the normal rock pressure of the field. Then, on account of the difference in the porosity of the rock, one well may produce but little gas, and another in the same locality be of greater capacity; yet whether large or small, they will, if closed, eventually reach the same rock pressure. This may require days, for, on account of the small difference in the pressure of different sections of the field, it equalizes slowly. A well that will produce 6,000,000 cubic feet of gas in twenty-four hours shows no greater rock pressure than one that produces only 500,000 cubic feet, though the first reaches its maximum rock pressure in a few seconds, while the latter may require hours. Rock pressure does not indicate the productiveness of a field.

Referring to this subject, Prof. Edward Orton says:* "The rock pressure of gas may perhaps be continued with little abatement of force until the end of the production of a field is near. The maintenance of pressure is no proof whatever of the maintenance of the

* Eighth Annual Report of the United States Geological Survey, 1889, p. 598.

supply. The last 1,000 feet of gas come out from the gas-holder with as much force as the first 1,000. In a field that contains both gas and oil, but in which the reservoirs of these is differentiated, the first sign of approaching failure will be the invasion of either level by the contents of the division next below."

GAS WELLS.

Generally speaking, the condition of a gas field must be judged by the condition of the wells. They are an index to the field, provided they have received proper care. It is a mistake to turn wells into a line and give them no further attention until a shortage of gas renders it necessary. Gas companies and owners of gas wells are fast learning this. The care should begin when the well is being drilled. First, none but experienced and responsible drillers should be employed. The location of the salt water horizon should be ascertained and the drill stopped before it is reached. Usually a small gas well is more valuable to a gas company than a large salt-water well. When the well is finished care should be exercised in tubing and packing. Only tubing perfect in every detail and not larger than is necessary, should be used. It is much easier to properly pack a well at first, even if the tubing has to be drawn and the packer reset, than it is to repack after the well has been closed a year or more. All gates, valves, etc., should be examined frequently, that they may be in working order when it is necessary to use them. At this time in the history of the field there are but few localities in which salt water does not appear within a comparatively short time after the well is turned into the line, even if the drill has stopped above it. This must be cared for, or the well will soon be useless. If the pressure of the gas is strong enough to bring it to the surface, through the well tubing, it can be separated from the gas by means of an automatic separator. Any water that may be in the line can be caught in properly arranged drips attached to it. The latter can be constructed and connected to the line without any particular skill or much expense.

If the pressure of the gas is not strong enough to lift the water through the well tubing, then the only practical thing to do is to place a small tube, say three-fourths of an inch in diameter, to the bottom of the well. Properly arranged, a small amount of gas will lift the water through this tube, thereby cleaning the well, and the gas will pass into the line comparatively dry. The tube need not be left open all the time, but opened at intervals, as often as necessary, to relieve the well of the salt water.

Where it is not practical to use either separator referred to above, and the rock pressure is sufficient, the well should be opened often enough to allow it to relieve itself of the accumulated water. This will waste a small amount of gas, but the damage to the field will not be as great as it is when the water is allowed to accumulate until it overpowers the pressure of the gas and hermetically seals it in the rock. Ordinarily the small inner tube is altogether practical, and with it the salt water can be successfully resisted, for a time at least, and the life of the well prolonged. The pressure of the gas will raise the water in the small tube long after it fails to lift it in the larger well tubing.

As to the number of wells in the gas field, either abandoned or productive, I do not attach much importance, except for statistical purposes. To get exact figures is almost an impossible task. Some gas companies have kept accurate records of all wells drilled and a history of the same from the beginning. Based upon the most reliable data obtainable, I submit the following estimate:

First—Number of wells drilled for gas since March 14th, 1886	5,400*
Second—Number of wells abandoned since March 14th, 1886	2,800
Third—Number of wells producing gas January 1st, 1898.	2,600

WASTE OF NATURAL GAS.

So much is being said about the waste of natural gas at this time that a reference to the subject in this paper is hardly necessary. At most the condition, at present only, will be noticed. The extravagant use and vandal-like waste of natural gas in the past is common history. That the future of the natural gas industry depends much upon how this fuel is used from this time on; upon whether it is used economically or otherwise, no one will deny. In the past the public has given but little heed to the warnings given either from this department or other sources, regarding the magnitude of the gas waste, and the certain results of the same.

On account of some extraordinary wastes this year, the public has become aroused. I refer to the waste of gas occasioned by the efforts that are being made in high-pressure gas territory to develop an oil field. Oil has been found in many localities on the northern and eastern border of the gas area since 1886. Though the oil production

* This does not include wells in which no gas was found.

in that section has involved the waste of some gas, owing to the proximity of the two fields, the amount has been insignificant compared with the waste in the gas field. The gas from the oil wells in the vicinity of Montpelier, Van Buren, Pennville and Geneva is not sufficient for drilling and pumping purposes. Pipe lines are necessary to procure fuel to develop the oil territory.

Indications of oil have been noticed in a number of localities in the gas field since its discovery. The first attempt to develop an oil field in the "heart" of the gas field was last spring, at Alexandria. A well completed on the Nimrod Carver farm, two and one-half miles northeast of Alexandria, April 23d, proved not only to be a good oil well, but a very large gas well. The result of that "find" can not be given now. Since that time 69 wells have been drilled for oil in that section of the field. Of these, 30 produce both gas and oil, the remainder being either "dry holes" or gas wells only. The waste of gas from the beginning has been enormous; increasing, of course, with each new well. The oil operators, as a class, while pretending to be opposed to the waste of gas, have shown no disposition to save it.

The manufacturers of Alexandria and the surrounding cities became alarmed about the future of their fuel supply as soon as the first oil well was drilled, but curious as it may seem, merchants, business men, etc., of Alexandria have from the first until quite lately seemed indifferent to the waste of the product that caused their city to grow from a small village to a modern city. At one time not fewer than 25,000,000 cubic feet of this valuable fuel escaped into the air every day, and the rock pressure of the gas in the immediate vicinity of Alexandria decreased during the summer from 200 to 125 pounds, and yet the public generally seemed to think that the oil industry was an advantage to the town. It is very difficult to enforce the law under the conditions above stated. Any attempt made to enforce a law which interfered with the oil industry in the least was at once branded as an improper interference on the part of the State with the rights of the people. Soon after the oil development began at that place I filed a number of affidavits against oil-well drillers for burning large natural gas torches for drilling purposes. The first case was tried at Alexandria. The defendant did not deny burning the flambeau, claiming that it was necessary to light the derrick. The law violated by burning the flambeau had been declared constitutional by the highest court in the State but a few weeks previous, and yet a jury, composed of merchants, business men and farmers, after deliberating five minutes, brought in a verdict of "not guilty." I relate this to show the sentiment with which we have had to contend at that place.

However, I am glad to say that a change has been wrought. From some cause or other the people have become aroused to the importance of the subject and are aiding me now in every way possible to suppress the waste of natural gas. Parties who drilled for oil during the early excitement are now the most enthusiastic supporters of the law and the efforts to suppress the waste of gas.

THE NATURAL GAS LAW.

The law enacted in 1893 to prohibit the waste of gas from wells provides, in Section 1, "That it shall be unlawful for any person, firm or corporation having possession of any natural gas or oil well, whether as contractor, owner, lessee, agent or manager, to allow or permit the flow of gas or oil from any such well to escape into the open air, without being confined in such well or proper pipes or other safe receptacle for a longer period than two (2) days, next after gas or oil shall have been struck in such well. And thereafter all such gas or oil shall be safely and securely confined in such well, pipes or other safe and proper receptacles."

The penalty for the violation of this section, as specified in Section three (3) of the same Act, is as follows: "Any person or corporation violating any provision of this act shall be liable to a penalty of two hundred dollars (\$200.00) for each and every such violation, and to the further penalty of two hundred dollars (\$200.00) for each ten days during which such violation shall continue; and all such penalties shall be recoverable in a civil action or actions in the name of the State of Indiana, for the use of the county in which such wells shall be located, together with reasonable attorney's fees and cost of suit."

It also provides in Section four (4) of the same Act, that "Whenever any person or corporation in possession or control of any well in which natural gas or oil has been found shall fail to comply with the provisions of this act, any person or corporation lawfully in possession of lands, situate adjacent to or in the vicinity or neighborhood of such well, may enter upon the lands upon which such well is situate and take possession of such well from which gas or oil is allowed to escape in violation of the provision of Section 1 of this Act, and pack and tube such well and shut in and secure the flow of gas or oil, and maintain a civil action in any court of competent jurisdiction in this State against the owner, lessee, agent or manager of said well, and each of them, jointly and severally, to recover the cost and expense of such tubing and packing, together with attorney's fees and costs of suit. This shall be in addition to the penalties provided in Section three (3) of this Act."*

*See Acts 1893, p. 300.

It will be noticed that the law is not criminal, but involves the infliction of a penalty for its violation, the same being recoverable in a civil action in the name of the State of Indiana for the use of the county in which the well is located. Every violation of this law during the past year has been reported to the prosecuting attorney of the county in which the law is violated, with the necessary information for a civil complaint, which always includes the location of a well, the date when completed, the kind of a well and the estimated capacity, together with the name of its owner, lessee or manager. Information for 34 complaints have been filed since the 1st of last May. The first case to come to trial was the "State of Indiana, for the use of Madison County vs. The Ohio Oil Company." In this case, as in all others where the State is endeavoring to prevent the waste of natural gas or oil, it is contended by the State that gas and oil are the property of the State, and as such the State has a right to prevent their waste and control their use. In the above case, the only one that has come to trial, the State obtained judgment in the Circuit Court for the full amount asked in the complaint and attorney's fees. The case was promptly appealed to the Supreme Court of Indiana, and a decision from that tribunal is soon expected.

As to the adequacy of the present statute to prevent the waste of gas from oil wells, it is hardly necessary to speak now. If its provision can be enforced, I believe it to be an adequate remedy. With the certain infliction of a penalty of two hundred dollars (\$200.00) for the first offense, and two hundred dollars (\$200.00) for each ten days thereafter, so long as gas is allowed to escape from the well, oil operating in Indiana can not be a very profitable business. The greatest objection to the law as it now is, is that it involves the tedious delay of a civil action. This means much, when millions of feet of gas are escaping into the air daily.

I am inclined to believe that the provision for tubing and closing wells as provided in Section four (4) of the Act will never be a practical remedy. While its application would be a quick and effectual remedy, citizens dislike very much to attempt to interfere with their neighbors' business, which would doubtless in some cases invite a breach of peace and possible litigation.

The question as to whether injunctive relief can be had to stop the waste of gas is now before the Supreme Court of the State in two cases. One, the Lippincott Glass Company vs. the Ohio Oil Company, is an action brought in the Madison Circuit Court to enjoin the defendant, the Ohio Oil Company, from allowing natural gas to escape

into the open air from an oil well. In this case the defendant demurred to the complaint, and the court sustained the demurrer. Judgment was rendered against the plaintiff for costs.

The other case is similar to the one above, except that the plaintiff is the State of Indiana. It was brought in the same court. Three cases, then—The State of Indiana *vs.* the Ohio Oil Company, to decide the constitutionality of the "penalty law;" The Lippincott Glass Company *vs.* the Ohio Oil Company, to decide the right of an individual to enjoin persons owning gas or oil wells from permitting the flow of gas or oil from such well to escape into the open air, and a similar action brought in the name of the State of Indiana for the same purpose—are now before the Supreme Court. Briefs have been submitted in each case, and oral argument will be heard by the court the 25th of this month. Much depends upon the results of these cases. The State has, and will use, every means at her command to stop the unlawful waste of one of its most valuable resources.

The people living in eastern central Indiana and the surrounding cities have been privileged to use for the past ten years the cheapest, cleanest and most satisfactory fuel known to man. The supply is limited. Its life depends upon how it is used in the future. With these facts in mind, and the history of other fields, and the past of this field an open book, how much longer will the people living in the gas belt remain indifferent to the present extravagant use and waste of this fuel?

So great has been the waste from oil wells during the past year that other classes of waste seem comparatively insignificant. In some cases this extraordinary waste, which we hope to suppress soon, has been used as an excuse for the extravagant use and waste in other localities; while in other instances it has served to arouse gas consumers to the true situation, and the necessity for a combined exertion toward husbanding the gas supply.

I think it will be conceded that no one is more vitally interested in the future of the natural gas industry than are the manufacturers of the gas belt. Its fuel resources were the principal incentives for the location of a majority of the gas belt factories. Numerous manufacturing institutions are enjoying an unexampled prosperity on account of the small fuel expense. Considering all the conditions, we have a right to expect them to set the example and to practice all the economy possible in the use of one of the chief agents of their prosperity, and yet, in not a few instances, quite the reverse is found to be true. To charge all manufacturers with wasting gas or even using it,

extravagantly would not be just, but an examination will convince any one that a majority use more for both fuel and light than is necessary.

It can not be said that manufacturers do not know and appreciate the value of gas as a heat-producing power. This extravagant use of fuel can not be charged to a lack of knowledge of conditions, except, probably, in a very few instances, but to a number of causes. As I have said before, the "free gas" idea that was held before manufacturers so long has had a bad influence. The seeming abundance at the point of consumption, the heavy draught that some wells have honored for years, and the small cost of the same, if not free, is responsible in no small degree for the prodigality in the use of gas in some localities. To refer to the mistakes in the past, however, is of little use, unless the future is profited thereby.

One of the chief avenues of waste in the factories of the gas belt is the lighting system in general use. Most of the factories are lighted with natural gas, and the burner used in many instances is simply the open end of a small pipe. Natural gas as an illuminant is not a success. It produces a very poor light, and when its value as a fuel is considered, it is expensive. That it is convenient for this purpose when used as a fuel is the most that can be said in its favor. Some of the larger manufacturing institutions have substituted electric lights for it. I realize that this is not practicable in some of the smaller factories, nor is the use of domestic lights any more so. However convenient or necessary it is to use natural gas for lighting purposes, I am quite sure that it is entirely unnecessary to allow large and wasteful torches to burn night and day, in all departments of the factory, whether operating or not. It is not always the largest burner or the one that consumes the most gas that makes the best light. Economical burners should be used and all lights turned out when not in use.

Of the many factories that I have visited the past year, but few were securing perfect combustion. In some instances the burners, mixers, etc., were so unscientific and ill-arranged that perfect combustion was not possible. Even if the apparatus for consuming natural gas is scientific in its construction and properly arranged, it needs constant care to insure the best results. Then, what the natural gas industry needs most in this line, is that all fuel consumers ascertain the true condition of the supply and its value to them and the public and apply business principles to the question.

Before leaving this subject I desire to say that there are a few manufacturers in the gas belt, and the number is increasing, that fully appreciate the value of this fuel and use it accordingly. They exercise

the same care in the use of their fuel that they do in the use of any other ingredient of their manufactured product. They would as soon waste one as the other.

The pipe lines within the gas area, including tributary and service lines, are in better condition than at any time during the history of the field. During the last two years most of the lines have been thoroughly overhauled. Pipe with the most approved joints has taken the place of the lead joint pipe that had been in service for a number of years, and where the pipe was not changed the joints have been carefully inspected, and air-tight clamps used where necessary. The repairs made have usually been of a permanent nature, and I anticipate but little trouble from pipe-line leaks in the future.

The chief trouble from this source has usually come from small lines, "farmer lines," service lines, etc. Hundreds of miles of this kind of pipe thread the "gas belt." Much of it belongs to small co-operative plants in the rural districts, and with these it is frequently very difficult to fix the responsibility for the bad condition of the lines. Natural-gas leaks along the highway are not only wasteful and dangerous to the public, but damaging to the pipe. The sulphuretted hydrogen contained in the gas is absorbed by the water and oxidized by contact with air to sulphuric acid, which readily attacks the pipe, forming sulphate of iron or copperas. The above acid attacks the pipe to such a degree that it is often eaten entirely through. These small lines have been the source of much trouble during the past, and I realize how difficult it is to keep small pipes lying on top of the ground, subject to a varying temperature, in repair. Watchfulness and prompt action is the only remedy. A number of gas companies keep men whose sole duty is to keep the lines in repair. This is advisable.

In the early history of the gas field one of the greatest avenues of waste was the hundreds of flambeaux permitted to burn throughout the gas belt night and day. There were sections of the field in which every village street, highway and farm yard were illuminated with natural gas torches. The amount of gas consumed by these lights was simply enormous. Not unfrequently was the gas allowed to burn at well pressure from the open end of a one-inch pipe; in fact, the volume of gas had to be strong enough to create a flame capable of resisting the wind and rain, or the flambeau would be of no value, and even the largest flambeau made a very unsatisfactory light. For most purposes a "jumbo" burner, enclosed in a glass globe, gives a better light, and does not consume over one-sixtieth of the gas consumed by an average flambeau. To prevent this great waste of the fuel resources of the State, the General Assembly of 1891 enacted a

law prohibiting the use of natural gas in flambeaux, and prescribing how it may be used as an illuminant.* This law encountered much opposition from the beginning. Public sentiment was so opposed to it that it was almost impossible to successfully enforce it. When an effort was made to do the same, its constitutionality was questioned.

Soon after taking charge of this department I caused a suit to be brought in Blackford County to enforce this law. In the Circuit Court the defendants entered a motion to quash the affidavit, and thereby attacked the constitutionality of the law. The court overruled the motion to quash. The case was appealed to the Supreme Court, and in a very short time afterward that Court rendered a unanimous decision holding the law constitutional and enunciating the following propositions of law:

First—Natural gas, in its original state, is wild by nature, and, like game, fish and birds, belongs to the sovereign.

Second—When lawfully brought to the service and reduced to subjection and control, it becomes the property of him who produces it.

Third—Being the property of the sovereign, the Legislature, which is the representative of the sovereign people, may prescribe such regulations as it may choose, with reference to the development and production of natural gas, or may prohibit its production at all, as it may prohibit the taking of certain game, the preservation of which it deems important to the general welfare.

Fourth—Natural gas is an explosive and poisonous substance, and as such is subject to the police control of the State, under which the Legislature may, by law, surround its use and protection with such safeguards as may be deemed necessary to insure the safety of persons and property.

Fifth—Being within the police power, both in its character as property and in its quality as a dangerous element, the Legislature and not the courts, is the exclusive judge of what restrictions are necessary and reasonable in the premises.

Sixth—The Legislature has a right not only to prohibit waste, but to determine what acts shall constitute waste of natural gas, and the determination of such question is not an usurpation of judicial power, but is properly an exercise of legislative discretion.

Seventh—The right to regulate the use of natural gas, under its police power, exists not only because of its physical characteristics, and its primary ownership, but rests on the principle that whatever affects the general welfare of the people is a subject of police supervision.

* Acts 1891, p. 55.

Eighth—Nor is the operation of the police power confined, as has been frequently contended, to questions of public morals, public safety, or the public health, and kindred subjects; but it embraces equally everything that affects the general commercial welfare of the State.

Though the violation of this law has caused but little trouble since the decision of the Supreme Court, it is but just to say that even before the courts had decided the above case a change had been wrought in the public mind. The law had begun to be looked upon with more favor.

THE FUTURE OF THE GAS BELT.

What will be the future history of the Indiana natural gas field? How long will natural gas last? These have been the regulation questions for the last five years, and doubtless will be until the history of the field is completed. There are persons at this late day who believe that the supply of natural gas will be sufficient for this generation. That so many people in the past have been, or seemed to be, at least, wholly indifferent to the way natural gas has been used, is not surprising. A very small per cent. of all the consumers of this fuel have given any thought to either the theoretical or practical phases of the natural gas question. They have been gas consumers, and that is all. Few there are, indeed, that are prepared to defend any particular theory accounting for the generation, storage and pressure of this gaseous fuel. In most localities there has been plenty of gas to date. The service during the past two years has been better than at any time previous, owing, in most cases, of course, to the improved facilities for transporting, distributing and controlling the gas. Those that know nothing about natural gas, except what they learn at the point of consumption, are ill-prepared to judge of the future, and those who have a good knowledge of the field know but little except that the supply is failing. Occasionally some one will venture to inform you how long gas will last, but usually these persons are compelled to revise their opinions from year to year, as unforeseen conditions arise. Natural gas was first used as a fuel in the Indiana field in 1886. For eleven years it has stood an enormous draught. The field did not show any material signs of exhaustion until 1890. Since that time the evidence has been accumulating. Salt water is the most aggressive enemy with which the natural gas field has to contend. It made its appearance at the edge of the field, and is advancing towards the center. Where it has completely overrun the gas territory the wells are no longer productive. The heavier the draught, the more intru-

sive is the salt water. The area in the heart of the field in which wells free from this agent can be found is comparatively small, and is decreasing in size yearly. The time when the entire field will succumb to its influence can not be far distant. Eleven years ago the rock pressure of the entire field was 325 pounds. Now the average pressure of the productive area, which is very much less than the original gas field, is less than 200 pounds. The average yearly decrease during the past three years has been 20 pounds, the decrease for the past year being near 25 pounds. And in connection with the above it is safe to say that a majority of the wells of the field will cease to be serviceable when the rock pressure reaches 100 pounds. This estimate is too low rather than too high. As the supply decreases, and the price advances, the consumption will naturally become lighter. Factories will use gas only where it is absolutely necessary, and supplement with other fuel; and, finally, when natural gas is used, only for domestic purposes, those that can afford it will use it for a considerable time after it has ceased to be a manufacturing fuel, or even a universal domestic fuel.

A LIST OF NATURAL GAS COMPANIES IN INDIANA JAN. 1, 1898.

ALLEN COUNTY.

Ft. Wayne Natural Gas Co., Ft. Wayne.

BLACKFORD COUNTY.

Baily Natural Gas Co., Hartford City.

Citizens' Natural Gas Co., Montpelier.

E. C. Storms Natural Gas Co., Roll.

Hartford City Natural Gas and Oil Co., Hartford City.

Linbark Gas and Oil Co., Dunkirk.

Marion Creek Natural Gas Co., Priam.

Millgrove Natural Gas Co., Millgrove.

Montpelier Natural Gas, Oil and Mining Co., Montpelier.

Peck Natural Gas Co., Hartford City.

People's Natural Gas Co., Hartford City.

Trenton Natural Gas Co., Priam.

Walnut Street Natural Gas Co., Hartford City.

CLINTON COUNTY.

Indiana Natural and Illuminating Gas Co., Indianapolis.

Terhune and Kirkland Natural Gas Co., Kirkland.

DECATUR COUNTY.

Citizens' Gas Co., Greensburg.
Consumers' Natural Gas Co., St. Paul.
Fourth Ward Natural Gas Co., Greensburg.
Greensburg Natural Gas, Oil and Water Co., Greensburg.
Hamilton Natural Gas Co., Greensburg.
Muddy Fork Natural Gas Co., Greensburg.
St. Paul Oil, Gas and Water Co., St. Paul.
Newton Natural Gas Co., Greensburg.

DELAWARE COUNTY.

Buck Creek Natural Gas Co., Muncie.
Cammack Natural Gas and Mining Co., Cammack.
Compromise Natural Gas Co., New Burlington.
Cleveland Gas Co., DeSoto.
Co-operative Gas, Light and Fuel Co., Yorktown.
Co-operative Fuel and Gas Light Co., Gaston.
Co-operative Natural Gas Co., Daleville.
Cowan Exploring and Gas Co., Cowan.
Delaware Natural Gas and Mining Co., Albany.
DeSoto Natural Gas and Mining Co., DeSoto.
Eaton Mining and Gas Co., Eaton.
Farmers' Natural Gas and Petroleum Oil Co., Yorktown.
Farmers' Natural Gas and Oil Co., Albany.
Granville Citizens' Natural Gas Co., Granville.
Gaston Gas and Mining Co., Gaston.
Manufacturers' Fuel Gas Co., Muncie.
Manufacturers' Natural Gas Co., Muncie.
Muncie Natural Gas Co., Muncie.
Niles Natural Gas Co., Dunkirk.
Oakville Natural Gas Co., Oakville.
Reed Station Natural Gas Co., Reed Station.
Ross & Fullheart Gas Co., Muncie.
Royerton Natural Gas Co., Royerton.
Selma Natural Gas Co., Selma.
Mutual Natural Gas Co., Gaston.
Walker Natural Gas and Oil Co., Gilman.
Yorktown Natural Gas and Oil Co., Yorktown.

FAYETTE COUNTY.

Connersville Natural Gas Co., Connersville.

GRANT COUNTY.

Arcana Gas Co., Arcana.
Barren Creek Gas Co., Fairmount.
Citizens' Gas Co., Gas City.
Citizens' Gas Co., Fairmount.
Citizens' Gas Co., Swayzee.

Citizens' Gas Co., Marion.
Deer Creek Mining Co., Hackleman.
Fairmount Mining Co., Fairmount.
Fowler Gas Co., Fowler.
Haw Run Gas Co., Roseburg.
Herbst Natural Gas and Mining Co., Herbst.
Jadden Gas Co., Jadden.
Jonesboro Mining Co., Jonesboro.
Lake Branch Mining Co., Upland.
Landessville Gas Co., Landessville.
Mississinewa Mining Co., Marion.
New Cumberland Mining and Gas Co., New Cumberland.
Pipe Creek Natural Gas Co., Roseburg.
Roseburg Natural Gas Co., Roseburg.
Swayzee Mining Co., Swayzee.
Triumph Gas Co., Fairmount.
Sweetser Natural Gas Co., Sweetser.
Upland Mining Co., Upland.

HANCOCK COUNTY.

California Natural Gas Co., Maxwell.
Citizens' Natural Gas Co., Greenfield.
Cushman Natural Gas Co., Fortville.
Don's Natural Gas Co., Fortville.
Farmers' Natural Gas Co., McCordsville.
Fortville Natural Gas Co., Fortville.
Gilboa Natural Gas Co., Cleveland.
Greenfield Natural Gas Co., Greenfield.
Independence Natural Gas Co., Greenfield.
McCordsville Natural Gas Co., McCordsville.
Mohawk Natural Gas Co., Mohawk.
Scrabletown Natural Gas Co., Wilkinson.
Vernon Natural Gas Co., Fortville.
Westland Natural Gas Co., Westland.
Wilkinson Natural Gas Co., Wilkinson.
Willow Branch Natural Gas Co., Willow Branch.

HAMILTON COUNTY.

Atlanta Natural Gas Co., Atlanta.
Bethlehem Natural Gas and Oil Co., Cicero.
Big Springs Natural Gas Co., Big Springs.
Buffalo Corner Natural Gas Co., Arcadia.
Carmel Natural Gas Co., Carmel.
Central Gas Co., Westfield.
Cicero Natural Gas Co., Cicero.
Citizens' Natural Gas Co., Atlanta.
Citizens' Natural Gas and Oil Co., Jolietville.
Clarksville Natural Gas Co., Clarksville.
Fall Creek Township Natural Gas Co., Fisher's Switch.
Hortonville Natural Gas Co., Hortonville.

Keck Natural Gas Co., Omega.
Noblesville Natural Gas and Improvement Co., Noblesville.
Nora Natural Gas Co., Nora.
Olio Natural Gas and Oil Co., Olio.
Stony Creek Natural Gas Co., Noblesville.
Strawtown Natural Gas Co., Strawtown.
Westfield Gas and Milling Co., Westfield.

HENRY COUNTY.

Cadiz Natural Gas Co., Cadiz.
Central Natural Gas Co., Cadiz.
Citizens' Natural Gas Co., Knightstown.
Citizens' Natural Gas Co., Middletown.
Enterprise Natural Gas Co., New Castle.
Farmers' Free Gas Co., Mt. Summit.
Farmers' Natural Gas Co., Middletown.
Farmers' Natural Gas Co., Spiceland.
Gronendyke Natural Gas Co., Middletown.
Honey Creek Natural Gas Co., Honey Creek.
Kennard Natural Gas Co., Kennard.
Knightstown Natural Gas Co., Knightstown.
Mechanicsburg Natural Gas Co., Mechanicsburg.
Montgomery Creek Natural Gas Co., Greensboro.
Moreland Natural Gas Co., Moreland.
Ogden Natural Gas Co., Ogden.
Spiceland Natural Gas Co., Spiceland.
Sulphur Springs Natural Gas Co., Sulphur Springs.
Welcome Natural Gas Co., Knightstown.

HOWARD COUNTY.

Flabby Natural Gas Co., Plevna.
Greentown Natural Gas Co., Greentown.
Howard Natural Gas, Oil, Mining and Pipe Line Co., Sycamore.
Jerome Natural Gas Co., Jerome.
Kokomo Natural Gas and Oil Co., Kokomo.
J. M. Leach Natural Gas Co., Kokomo.
Liberty Natural Gas Co., Plevna.
Manufacturers' Pipe Line Co., Kokomo.
Pittsburg Plate Glass Co., Kokomo.
Sycamore Natural Gas Co., Sycamore.

HUNTINGTON COUNTY.

Huntington Light and Fuel Co., Huntington.
Warren Natural Gas Co., Warren.

JAY COUNTY.

Citizens' Natural Gas and Oil Co., Portland.
Dunkirk Natural Gas and Oil Co., Dunkirk.
Pennville Natural Gas and Oil Co., Pennville.

Portland Natural Gas and Oil Co., Portland.
Red Key Natural Gas and Oil Co., Red Key.
Richmond Natural Gas and Oil Co., Red Key.

MADISON COUNTY.

Alexandria Mining and Exploring Co., Alexandria.
Alfont Natural Gas and Oil Co., Alfont.
Bear Creek Natural Gas Co., Perkinsville.
Citizens' Natural Gas Co., Anderson.
Citizens' Natural Gas and Mining Co., Elwood.
Citizens' Natural Gas Co., Summitville.
County Line Natural Gas and Oil Co., Ingalls.
Dyar's Creek Gas and Oil Co., Lapel.
Elwood Natural Gas and Oil Co., Elwood.
Fall Creek Natural Gas Co., Hamilton.
Farmers' Mutual Gas Co., Summitville.
Foster's Branch Natural Gas Co., Hamilton.
Green Township Natural Gas Co., Hamilton.
Gilman Natural Gas Co., Gilman.
Hardman Natural Gas and Oil Co., Markleville.
Lapel Natural Gas and Oil Co., Lapel.
Markleville Natural Gas and Oil Co., Markleville.
Mendon Natural Gas and Oil Co., Mendon.
Perkinsville Natural Gas and Oil Co., Perkinsville.
Pendleton Natural Gas Co., Pendleton.
Summitville Mining Co., Summitville.
Victory Natural Gas and Oil Co., Summitville.

MARION COUNTY.

Consumers' Gas Trust Co., Indianapolis.
Indianapolis Natural Gas Co., Indianapolis.
Manufacturers' Natural Gas Co., Indianapolis.
United States Encaustic Tile Co., Indianapolis.

MIAMI COUNTY.

North Grove Natural Gas Co., Peru.
Xenia Natural Gas and Pipe Line Co., Converse.

RANDOLPH COUNTY.

Citizens' Natural Gas Co., Parker.
Eastern Indiana Natural Gas and Oil Co., Union City.
Elkhorn Natural Gas Co., Farmland.
Farmland Natural Gas Co., Farmland.
Lynn Natural Gas Co., Lynn.
Parker Natural Gas Co., Parker.
Rock Oil Co., Winchester.
Windsor Natural Gas Co., Windsor.
Ridgeville Natural Gas Co., Ridgeville.

RUSH COUNTY.

Big Four Natural Gas Co., Carthage.
Carthage Natural Gas Co., Carthage.
Citizens' Natural Gas Co., Manilla.
Farmers' Natural Gas Co., Mays.
Five Points Natural Gas Co., Sexton.
Hackleman Natural Gas Co., Mays.
Homer Natural Gas Co., Homer.
Manilla Natural Gas Co., Manilla.
Milroy Natural Gas Co., Milroy.
Peoples' Natural Gas Co., Rushville.
Riverside Natural Gas Co., Rushville.
Rushville Natural Gas Co., Rushville.
Rushville Fuel Co., Rushville.
Walnut Ridge Natural Gas Co., Carthage.
Walker Natural Gas Co., Carthage.

SHELBY COUNTY.

Citizens' Natural Gas Co., Shelbyville.
Fountaintown Natural Gas Co., Fountaintown.
Morristown Natural Gas Co., Morristown.
Southern Indiana Natural Gas Co., Shelbyville.
Waldron Natural Gas Co., Waldron.

TIPPECANOE COUNTY.

Lafayette Natural Gas Co., Lafayette.

TIPTON COUNTY.

Citizens' Natural Gas Co., Tipton.
Citizens' Natural Gas Co., Windfall.
Lutz Natural Gas Co., Goldsmith.
Tipton Line and Improvement Co., Tipton.
Tipton Light, Heat and Power Co., Tipton.
Windfall Natural Gas, Oil and Mining Co., Windfall.

WABASH COUNTY.

Lafontaine Natural Gas and Oil Co., Lafontaine.
Somerset Natural Gas and Oil Co., Wabash.

WAYNE COUNTY.

Hagerstown Natural Gas Co., Hagerstown.
Richmond Natural Gas Co., Richmond.

MISCELLANEOUS.

Central Contract and Finance Co., Lima, Ohio.
Indiana Natural Gas and Oil Co., Chicago, Ill.
Logansport and Wabash Valley Gas Co., Lafayette, Ind.
Ohio-Indiana Gas Co., Lima, Ohio.